



National Aeronautics and Space Administration

Immediately Dangerous to Life and Health

The Cost of Failing To Identify and Mitigate IDLH Hazards

Senior Management ViTS Meeting

Sept. 8, 2015

Hal Bell

Deputy Chief, Safety and Mission Assurance



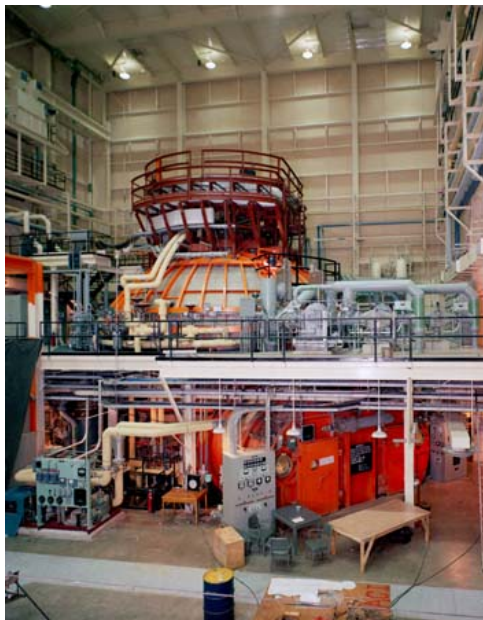
This and previous presentations are archived at
<https://sma.nasa.gov/safety-messages>

DuPont La Porte Gas Leak, 2014

DuPont La Porte Facility

- Nov. 15, 2014: Four workers died and a fifth was hospitalized after exposure to a 24,000-pound methyl mercaptan gas leak at the DuPont chemical plant in La Porte, Texas.
 - Methyl mercaptan is added to natural gas to provide a warning odor.
 - DuPont said the leak was contained at about 6 a.m. Central Standard Time, approximately two hours after the workers were overcome.
 - DuPont stated that the leak began when a single valve on a container of methyl mercaptan malfunctioned.
- July 22, 2015: U.S. Chemical Safety Board (CSB) public hearing:
 - Additional releases occurred during the investigation.
 - "...the incident took place...enclosed within a building that has no documented design function and appears to serve no manufacturing purpose."
 - "Housing the process equipment inside the enclosed building introduces highly toxic chemical exposure and asphyxiation hazards to personnel that DuPont has not effectively identified or controlled"
 - Following Bhopal (1984), DuPont modified its LaPorte methyl isocyanate (MIC) process using inherently safer design (ISD): open building structure, equipment directing leaks to an incinerator. **No modifications were made to methyl mercaptan or chlorine facilities. What related events can provide lessons?**

JSC Chamber B Type B Mishap, 2010



- **Event:** Chamber B is a human-rated thermal vacuum test facility. During maintenance activities inside, an electrical technician climbed a ladder in Chamber B to install a vacuum transducer. The technician “noticed something was not right” and started to descend the ladder, but briefly lost consciousness. The technician fell to the floor and sustained minor injuries.
- **Proximate cause:** The technician climbed unknowingly into an oxygen deficient atmosphere in the upper portion of the chamber.
- **Root causes:**
 - 1) Chamber entry requirements training was ineffective.
 - 2) There was no strict entry procedure required to enter or allow entry into the chamber.

3) The facility hazard analysis addressed hazards, but not all controls identified in the hazard analysis were enacted for operations. The analysis identified ventilation as a control, but did not specify when ventilation was needed. There was no procedure to provide ventilation before or during entry, or verification of safe atmosphere in breathing zones before entry.

- **Lesson: Potential for employee exposure to dangerous atmospheres may be hard to identify and assess.**

Xcel Energy Penstock Fire, 2007



- <https://nsc.nasa.gov/Resources/SFCS/vapor-trap>
- **Event:** Five industrial painters were killed while recoating a portion of tunnel in a remote mountainous area near an Xcel Energy hydroelectric station. The workers cleaned their equipment with a highly flammable solvent, which filled the tunnel with flammable vapor.
- **Proximate cause:** The vapor ignited and the resulting explosion blocked five painters from their only egress point by a wall of fire. Despite lengthy rescue attempts, all five painters were asphyxiated as smoke slowly filled the tunnel.
- **Underlying issues:**
 1. The tunnel's 4,000-foot length made it an exception to OSHA confined space classification.
 2. While Xcel and the recoating contractor assessed the tunnel as a confined space anyway, neither company treated it as such during actual work. Air monitoring was done only at the entrance, not 1,450 feet away at the actual work area on the day of the fire.
 3. Rescue capability was insufficient for the conditions present.
- **Lesson:** Even when hazard assessments are well-done, actual work planning and coordination may ignore those assessments.

STS-1 Pre-Launch Mishap, 1981



- <https://nsc.nasa.gov/Resources/SFCS/tough-transitions>
- **Event:** As ground crews worked diligently to prepare for the launch, a group of technicians collapsed inside Columbia's nitrogen-filled aft compartment after a countdown demonstration test on March 19. Nitrogen exposure would claim three of the technicians' lives.
- **Proximate Cause:** Test directors and other involved personnel lacked formal communication about the nitrogen purge extension and dropped access controls prematurely.

- **Underlying Issues:**

1. Nitrogen purge test procedures were unclear and incomplete; launch pad closure/opening criteria were not included. No provision for extending the test was included. Impact of an extension on other collateral operations were not considered.
2. Over 500 late-schedule deviations besides the nitrogen purge extension prevented integrated operations impact discussion and planning.
3. Ground processing teams worked to accomplish as many tasks as possible without coordinating with the Firing Room staff who were responsible for controlling integrated operations.

- **Lesson: Dynamic, complex scenarios can defeat layers of safety controls.**



IDLH Hazards Not Formally Identified

La Porte

- “PHA’s performed...did not sufficiently identify and control process hazards.”

JSC Building 32, Chamber B

- “There was no strict entry procedure required to enter or allow entry into the chamber.”
- The facility hazard analysis addressed hazards, but not all controls identified during the investigation were included...no procedure to implement ventilation before or during entry.”

Xcel Energy Penstock

- “Managers...failed to identify serious safety hazards involving use of flammable liquids inside a confined space.”

STS-1

- “The test procedure in progress did not contain adequate steps for clearing the vehicle/pad complex for hazardous operations or completely reopening the vehicle/pad complex for resumption of scheduled normal work.”
- “There was no formal coordination with any of the element test conductors by the NASA Test Director (NTD) immediately prior to opening the pad, although all test conductors had been involved in earlier discussion on the subject.”

Relevance to NASA

In every situation listed, the risk of personnel exposure to IDLH atmospheres was either not identified or underestimated.



Hazardous materials response services at Ames Research Center.

If hazard assessments identify a potential for an employee to be overcome by toxic or oxygen-displacing gases while doing normal work, risk owners should ask the following questions:

1. Are all controls identified in the hazard analysis in place?
2. Do those defenses work today?